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SCIENCE.—SUPPLEMENT.

FRIDAY, MAY 21, 1886.

THE AGRICULTURAL INDUSTRIES OF JAPAN.

It was not many years ago that Japan was looked upon as an uncivilized nation, and her remarkable development during the past two decades has been a subject of astonishment to the civilized world. It speaks well for the natural intelligence of her people that she has profited so well by the experiences of foreign civilization, and much can be expected in her future progress. Many conditions productive of evil in civilization have not yet found a place in her affairs, and in some respects the lower classes may be considered as occupying a higher plane than those of more favored European countries.

A recent paper¹ by Prof. M. Fesca, with the assistance of Mr. N. Tsuneto, presents one of the fullest accounts of the agricultural conditions and industries of this people that have so far appeared, from which we give an abstract of the more interesting portions.

Many important factors affecting the agriculture of Japan, as would naturally be supposed, have yet received comparatively little attention, although the results so far attained are surprising when we take into consideration the rapidity with which they have been produced. Especially is there need of a more scientific study of the climate and meteorological conditions. Most of the meteorological stations hitherto founded are along the seacoast, with but very few in the interior.

One of the chief hindrances to the development of Japanese agriculture has been the burdensome system of taxation, which is levied almost exclusively upon real estate, and which prevents the use of capital to any great extent. The high rate of interest, of which fifteen per cent is considered moderate, for money loaned upon real estate, almost prohibits its use. In those districts where agriculture has reached its chief development, it has been due almost wholly to unaided manual labor.

Agriculture can only reach its highest development when the producer owns the land, and especially when capital is unrestricted in its em-

ployment for its improvement or cultivation. Statistics, so far as they are available, however, show that lease systems, wherein compensation is derived either by division of crops or from money payments, predominate over independent tenures of land in Japan. In the dryer lands money-rent is usually paid, varying in amounts for the different crops raised. For rice-land the so-called 'half-crop' system is the more common one, though in reality a far larger proportion of the gross harvest returns is paid. Four-fifths of the crop go to the owner of the land; and, from the one-fifth remaining, all the costs of fertilizing and harvesting must be obtained, and which not seldom consume its substance. The remedy for these evils will only be found in the legal control of the lease systems, and more especially by a change in the system of taxation, which will relieve the land from the severe burdens now imposed upon it, and thus bring about more favorable systems of credit, admitting of the more extensive use of capital. At present the lessee of small farms derives only a very meagre income.

Another important factor which exerts a most depressing influence upon Japanese agriculture, is the difficulty and cost of transportation. The lack of water-ways, railways, and good roads in Japan is very sensibly felt. The pack-horse is the means upon which the chief reliance is placed for carrying; and upon the best roads the burden of three hundred and thirty pounds costs ten sen¹ per ri, while upon bad roads the cost may be quadrupled. This high cost of transportation influences in a very great degree the sale of farm produce. Rice commands the highest price among the grains, in Tokio the past year selling for one dollar per hundredweight. The cost of its transportation for twenty miles amounts to as much as its price. When this is compared with the cost of the transportation of wheat by railroads in America, some appreciation of the immense disadvantage under which Japan labors will be apparent. For this reason the regions of the coast are far more preferred for agriculture than the inland, every possible portion being utilized, while in the interior often large tracts of good land are left untilled.

Thus it will be seen that one of the chief demands of Japan is for better and cheaper means

¹ 100 sen = 1 yen, about 86 cents; 1.9 ri = 1 geographical mile. The Japanese terms are mostly reduced to their English equivalents.

¹ Die landwirthschaftlichen verhältnisse der Kai-provinz in beziehung zu denen des japanischen reichs, Mittheilungen der agronomischen abtheilung der kaiserlich japanischen geologischen reichsanstalt, April, 1886.

of transportation. Railroads, so far, have done little towards remedying the evil, and will not unless tariffs are sufficiently lessened to admit of more extended commerce. The distance between Tokio and Kofu is about sixty-four miles, one half of which is easily, the other with difficulty, passable. The cost of transportation by horses is nine yen per load (over two dollars per hundred-weight). The following market-prices at Tokio, of a few of the more important productions, will show the extent to which the cost of transportation affects the price :—

	Per cwt.	Cost of trans- portation from Kofu.
Tobacco (medium quality).....	\$15.50	15.5%
Cotton (medium quality).....	13.00	10.0%
Cotton (raw).....	5.30	25.3%
Silk-worm cocoons	66.00	1.9%
Silk-stuffs.....	333.00	0.5%

The great cost of transportation of raw or bulky articles has caused certain industries, as silk culture and weaving, where the manufactured material is of light weight and easily transportable, to be extensively prosecuted in the interior, especially by the women, and such industries are thus properly classed as agricultural.

Japanese statistics of agricultural productions are necessarily imperfect, but they are sufficient to afford a tolerably good idea of the resources of the kingdom, or at least of some portions of it. The area of the entire kingdom, as at present constituted, comprises 24,294 square ri (87,701 square miles), or 11,054,019 cho (27,082,346 acres). The following table will show the proportions of tilled, tillable, and other lands, together with the prices for the same :—

	Acres.	Percent of entire land.	Average price per acre.
Rice-land.....	6,805,027	23.80	\$194.00
Other tilled land.....	4,631,137	16.80	57.30
Forest-land.....	13,601,427	49.35	1.36
Tillable (uncultivated land)	1,890,150	6.85	1.00
Building-ground (villages and cities).....	871,350	—	500.00
Salt-yards.....	15,910	—	120.00

The unoccupied tillable lands are covered with scant vegetation, which serves for pasturage for stock, though little used : doubtless the figures given are too small, and should be increased at the expense of those for forest-land. The salt fields or yards (*salzgärten*) are the only sources of salt in Japan, and are for the evaporation of sea-water. Rock-salt and salt-wells have not, so far,

been discovered in the kingdom. Salt, it may be mentioned, furnishes a good example of the variation in the cost of transportation, as in some parts it commands nearly thirty times what it does in others. The rice-land, it will be seen, comprises nearly one-fourth of the entire superficial area, and commands more than three times the price of other tilled land.

The price of really valuable land can in no wise be considered as low, as compared with that of the agricultural lands in Germany. The price of rice-land is at least one-half greater, and, of the other grain-lands, about half as great.

The number of those engaged in agricultural industries throughout the kingdom, from the returns that are available, is as follows : males, 8,237,682 ; females, 7,398,431 ; total, 15,636,113. The entire population of the kingdom was nearly thirty-seven million ; and for such a distinctively agricultural nation as Japan, the proportion devoted to agriculture appears small. This disproportion may in part be attributed to the great number of officials, and petty shops and pedlers, — occupations which draw from the lower classes, by reason of the less labor required, and the comparatively less onerous taxation imposed upon them, than is the case in the agricultural pursuits ; and in part to the fact that those partially engaged in other pursuits are often not counted as agriculturalists. There are only about three-fifths of an acre of tilled land to each individual in the entire population, or less than three acres to the average family.

It will not be without interest to make some mention of the foods used by the people. The Japanese are almost exclusively vegetarians, — a fact that is to be deplored, from the detrimental influence it has upon the raising of live-stock. On the coast, fish and other sea-foods are used in considerable quantities ; but at a distance, from the ever-recurring element of transportation cost, these foods form only an immaterial proportion of the alimentation. Rice is the chief comestible, except in such higher regions where it cannot be raised, and where the cost of importation virtually prohibits its use. The percentages of the different foods consumed are as follows :—

Rice.....	53.00
Barley and wheat	27.00
Millet and other grain.....	13.90
Sweet-potatoes and garden-vegetables.....	6.00
Fruit.....	0.05
Algae.....	0.05

Farm-laborers are paid throughout the kingdom, on an average, in summer, 18 cents per day for the best men, and 13.3 for the best women ; for a poorer class of men the compensation is

12.5 cents, and of women 8 cents: in winter they are paid 14.5 and 9.1, and 9.8 and 5.5 cents respectively. This is in addition to board. The highest price paid in any province is, in summer, 27 cents for men, and 20 cents for women. The average price per year is \$30.50; the maximum, \$74; the minimum, \$13.70; in Tokio, \$31.40. Taking all things into consideration, in comparison with the sums paid for similar labor in Germany, farm-labor is decidedly dearer in Japan.

These high wages may be taken as an expression of a more uniform distribution of property than obtains in the European countries, and speak in favor, rather than against, the social conditions of the kingdom. There does not prevail that sharp contrast between luxurious wealth and hungering misery; and as a result, class hatreds, with all their attendant evils, are foreign to Japan. Wages, however, are much higher at present than they were even a few years ago. In some provinces during the last twenty years they have increased seven or eight fold.

It will be of interest to give the actual production of the staple products of the kingdom for 1882, as nearly as can be obtained from statistics.

	Entire production.	Per acre.
Rice (meadow and up-land).....	162,269,090 bush.	25.25 bush.
Barley.....	53,993,050 "	23.50 "
Wheat.....	12,782,380 "	14.1 "
Beans.....	11,927,819 "	11.9 "
Millet.....	14,981,874 "	—
Sorghum.....	367,784 "	—
Buckwheat.....	3,458,639 "	9.5 "
Potatoes.....	74,117,611 lbs.	3,700.00 lbs.
Sweet-potatoes.....	2,150,975,313 "	6.250 00 "

It is necessary to observe, in explanation of these figures (a calculation of which will show an apparently greater number of acres than are actually under cultivation), that in many cases two or even more crops are obtained annually from the same field.

The entire value of these crops reached, according to the statistics of 1882, the sum of 158,884,113 yen (\$123,462,655). This gives a gross sum of \$12.44 per acre, and less than \$8 for each individual engaged in agricultural pursuits. In comparing these figures with those of the averages of the eight older Prussian provinces, between the years 1859 and 1864 they are found to be more than one-third less. The net results, however, of the returns, per capita, are considerably less; scarcely, in favorable cases, reaching \$3.50. They do not, however, indicate the true condition of affairs. A laboring man requires for annual consumption, about five bushels of rice, and the average for man and woman may be placed at four bushels. As the cost of this quantity is over four dollars

(4.5 yen per koku=1.8 hectolitres), the people would be reduced to a much cheaper way of living, which is not the case. The exports and imports are comparatively trivial, and will nearly balance each other.

More than one-eighth of all the rice grown is consumed in the production of *sake*, the alcoholic drink universally used in Japan, leaving, on an average, about 3.5 bushels as the annual amount per capita. Adding to rice other productions, it is found that 5.7 bushels of grain represent the quantity annually consumed by each individual of the population, to which should also be added about 60 pounds of potatoes.

During the twelve years between 1868 and 1879 the entire export of rice amounted to a little over seven million bushels, with the imports a little more than twice that quantity. Of the other produce, figures cannot be given. It will thus be seen that the annual production of food-stuffs suffices for the entire population, although it is true the quota is by no means equally distributed throughout the population. The better-situated half takes the lion's share, to the deprivation of the lower class.

Statistics of the cultivation of rice sufficiently trustworthy to entitle them to our acceptance, reach back for nearly a thousand years, and show that there has been a steady decrease in the yield per acre. Thus in the period between 923 and 930 the area devoted to its culture amounted to 2,558,390 acres, with a yield of 95,924,326 bushels; while in 1868, with an area of 6,559,192 acres, the yield was only 157,153,500 bushels. Thus, while the entire area devoted to the crop has doubled, the crop itself has only increased about one-half. Undoubtedly a part of this is due to the added lands being less adapted to rice-cultivation.

The agriculture of Japan has progressed in its peculiar way without reference to stock-raising. For a very long period religious prejudices have not favored the use of flesh as a food, although it has not been strictly forbidden. There has been no demand for this food, and domestic animals were looked upon only as beasts of burden and sources of fertilizing-material. This exclusion of stock-raising has markedly influenced the extension of strictly agricultural industries. In the vicinity of the coasts the smallest portions of suitable land are cultivated, while at a distance the extent of untilled land becomes much greater. In thickly populated regions fertilizing-material, especially that from human sources, — the chief ones in Japan, — exists in much greater abundance, as also such material as fish-guano, seaweed, etc., furnished by the sea; but these cannot be made use of at any distance from the coast, for, under

the existing unfavorable conditions, they do not admit of being transported. In the regions remote from the coast and the more thickly settled districts, various substances, such as wood-ashes, the residue from grapes, cottonseed, beans, etc., are used for fertilizing-material; but the extent to which they can be employed is very limited, and for this reason some better source of compost-material is highly desirable for the further development of inland agriculture. The necessity of the introduction of stock-raising has been recognized in Japan, although its true value has hitherto not been rightly appreciated.

About eighteen years ago, Japan suddenly exchanged its mediaeval condition for one very different; and this must be taken into consideration in judging of the present state of affairs in that country, since, under such circumstances, one cannot wonder that errors have been committed, but, rather, that the results already reached have been so remarkable. Already a network of telegraph-wires covers the entire land, and railroads are increasing from year to year; and in the laws of the country undoubted improvements have been brought about. In the civilized countries of Europe the development of the modern condition from the mediaeval one was gradual; but in Japan this development has been not only more rapid, but also in many respects peculiar. Not only has it made use of many counsellors and teachers from other countries, but it has sent out a very considerable number of its own students to other lands, who have brought back many of the modern inventions and discoveries of civilized life. Such a process of development has been in many respects of great advantage to Japan, although not wholly without its elements of danger. They can avail themselves of the multitudinous results of civilization which have been slowly and laboriously acquired in European states in the many centuries, and at the same time avoid the many errors taught by painful experience, though it must be borne in mind that the old mediaeval conditions are not yet entirely done away with.

These conditions must be taken into account in treating of the development of live-stock industries in Japan. In the civilized nations of Europe, it is well known, that, until recently, live-stock was looked upon as a necessary evil, useful only as machines for the production of fertilizing-material. Circumstances were deemed fortunate when the income derived from the stock was sufficient to pay expenses, and thus furnish manure free of cost. In England scarcely a hundred years have elapsed since stock-raising has attained an independent position as a profitable industry, and in Germany its importance was not

appreciated till a much later period. While in many other agricultural and technical matters Japan's progress has been more rapid than was the case in Europe, the difficulties which stock-raising encounter are greater, rather than less, than were the European ones in past centuries.

In the live-stock industries of Japan the horse and the ox are the only animals which have attained any degree of importance. Sheep do not thrive in the moist climate, and attempts have shown the uselessness of endeavoring to introduce this branch of stock-raising. But little attention is paid to hog-raising, although circumstances would seem to indicate its profitability, and the opportuneness of its inception on a more extended scale.

The number of cattle in Japan is not only absolutely, but also relatively in proportion to the population, very small. In 1879 there were but 4.1 horses and 2.9 oxen or cows to every hundred inhabitants,—a number, for the latter, remarkably small. In the same year there was less than one head of cattle slaughtered for every thousand inhabitants for food, the consumption varying in the different provinces from five and a half per thousand to less than one per hundred thousand. Even in the large province of Musashi, in which the large flesh-consuming cities of Tokio and Yokohama lie, the consumption amounted to only 3.1 per thousand inhabitants.

It has been often asserted that the consumption of flesh in Japan is steadily increasing. Of the 1,075,520 head of cattle in Japan in 1877, 33,959 were slaughtered; in 1882 there were 1,159,750, of which 36,288 were slaughtered,—in both cases bearing the same percentage, 3.1, to the entire number. This percentage is very small, and it is seen that a large proportion of the stock must live to be very old, and die natural deaths.

Milk and butter, as will be understood, are unsalable in the interior, and non-transportable, and cheese and condensed-milk manufacturing requires more capital than is disposable in Japan. Further, the entire population has for butter and cheese a decided dislike, which is not wholly overcome even by those who have become accustomed to European diet.

Attempts have been made to improve the industry by the importation of foreign cattle; but this has been done without a proper study of the adaptability of different breeds to the peculiar climate and mountainous topography of the country, and the result has not been wholly satisfactory. Instead of introducing stock from the highlands of Scotland, Wales, or, better, from the mountain valleys of South Germany and Switzerland, Short-horn, Devon, and Hereford stock has been im-

ported. There were imported, largely from America, in 1877, 498 head; in 1882, 1,430. Another obstacle which stock-raising must encounter is the difficulty in the way of pasturage. The scant herbage is unfitted for blooded stock, and the raising of grasses or grain will be unprofitable. In the inland regions the farmers of small means often keep a horse or a cow, not for work, but solely for the manure derived from it. It shows strikingly the lack of capital everywhere so prevalent. When a farmer finds an ox or a cow too costly, he buys a superannuated or broken-down pack-horse that can hardly stand, feeds it, and carefully collects the manure.

Notwithstanding all the obstacles, the importation and improvement of cattle in Japan, the author believes, should certainly not be abandoned. By a proper study of natural conditions, stock-raising may do much toward bettering the circumstances of the Japanese people.

A BOOK-MANUFACTORY IN ANCIENT ROME.

IN the *Illustriertes schweizerisches unterhaltungsblatt für stenographen*, the *Publishers' weekly* finds an interesting account of the production of books in ancient Rome. It is stated therein, that, notwithstanding the Romans had no printing-presses, books were at that time produced much more quickly and in larger numbers than most modern works. Paper was used which was almost woven out of the fibre of the Egyptian papyrus, which grows to a height of ten feet, and which has given its name to paper. A Roman residing in Egypt assures us that the yield of his paper-manufactory would be sufficient to support an army, and whole shiploads of paper were sent from Egypt to Rome. Before books of any description were reproduced in large numbers, they were read mostly either in private circles or publicly, so that the author could adopt suggestions for the improvement of his work. Wealthy Romans used to own a large number of slaves for all kinds of services, which rendered labor cheap, as they cost nothing in many cases, and had only to be supported. They were mostly prisoners of war, the pick of nations, and often more cultivated (especially the Greeks) than their masters. They were consequently also employed in the education of Roman boys. The works of authors were dictated to a number of slaves, women also being employed for that purpose. Even among freemen and liberated slaves the desire to obtain employment became so great, that hundreds of willing hands could be had for writing books at a very low rate of wages. The instruction imparted in the work-

shops of Roman publishers necessitated a regular course of training, which was to teach the apprentices an easy and elegant handwriting. If a publisher had at his disposal, say, a hundred writers, and reckoning the working-day at ten hours, a document which took an hour to write would be multiplied in the course of a day to a thousand copies. The writers became in time expert to such a degree that they combined quickness with elegance. It must also be added that in cases where speed was the first consideration, the use of stenographic contractions became general, and we possess illustrations of their employment in the old manuscripts still in existence. We are also informed that both readers and copyists were instructed and trained, the former in the solution, the latter in the application, of contractions. Their object was to copy works as quickly as possible, the use of full words being only resorted to for the best works. The above brief account demonstrates the fact that the Romans made the nearest approach to the invention of printing, although they never attained to it. The movable stamps of iron or other metals used by the Romans for marking earthenware vessels or other utensils also prove this. But the art of rapid writing, which was perfected by them to an unusual degree, counteracted a further development, while the number of slaves and other willing hands at disposal, by which means the most astonishing results were obtained, operated in the same direction.

THE HEATING-POWER OF GAS.

THE introduction of the gas-engine and the increased use of ordinary illuminating-gas for domestic heating-purposes, renders its calorific properties of far more importance than they were a few years ago, says *Engineering*. The experiments made on this subject do not appear to have been very exhaustive, and, if we may judge by those we are about to quote, have not always been carried out with due care. M. Aimé Witz, whose researches in connection with the gas-engine are well known, has lately made some experiments in order to determine with greater accuracy the heating-power in ordinary French illuminating-gas. His apparatus was composed of an explosion-cylinder of nickel-plated steel 2.36 inches internal diameter and 3.54 inches high. The thickness of the metal was .079 of an inch. The top and bottom covers were tightly screwed on, rendering the chamber air-tight. Through the top cover a wire passed, and on the bottom was a valve for filling or emptying the receptacle. This cylinder was contained in a vessel 4 inches in diameter and